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ABSTRACT

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EFFECT ON INTENDED AND INCIDENTAL LEARNING FROM THE USE OF LEARNING OBJECTIVES WITH AN AUDIOVISUAL PRESENTATION

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

A paper presented to the Research and Theory Division of the 1979 AECT Convention by Robert Main, Associate Professor at the Center for Information and Communication Studies, California State University, Chico, California.

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ABSTRACT

This paper reports a controlled field experiment conducted to determine the effect and interaction of five independent varibles with an audiovisual slide-tape program: presence of learning objectives, location of learning objectives, type of knowledge, sex of learner, and retention of learning. Participants were university students in a general studies course. Test scores measuring intended and incidental knowledge were the dependent variables. The major finding supported Ausubel's subsumption theory in that use of learning objectives as an advance organizer presented before the slide-tape programs significantly increased intended learning. No significant loss was found for incidental learning. Indeed, from the direction of the data, the tendency was for the learning objectives to improve rather than lessen incidental learning. The use of the learning objectives before the presentation had no significant effects on the affective variables measured and did not detract from the students' evaluation of the program. To the contrary, the trend of the data indicated students receiving learning objectives prior to the presentation liked the program more than when no learning objectives were used.

Introduction and Background

The nonprint media are becoming increasingly important as educational tools for American schools. The increase in availability of educational media materials for school use has been dramatic. Twenty-five years ago, perhaps 25,000 nonprint instructional programs might have been available to the elementary and secondary schools of this country.[1] Today, the number of titles is nearing 500,000.[2] Because instructional media of many kinds are important in structuring what goes on in classrooms and what students do to learn, consideration of ways to improve their use is important.

It would be beneficial for teachers to have practical methods for influencing the efficiency and effectiveness of audiovisual materials selected for curriculum support. There is little in the literature to guide the teacher in the application of instructional theory to the nonprint media. The empirical evidence regarding learning objectives, advance organizers, and mathemagenic activities to facilitate learning is largely concerned with print materials.

Printed curriculum materials allow the learner a wide latitude in use--browsing, skipping, review, repetition. Through selection, pacing, and sequencing, the learner may individualize the material to his particular needs or preference. Audiovisual materials, on the other hand, are commonly fixed pace, fixed sequence presentations with content selected and organized for use with as wide an audience as possible.

The purpose of this study was to investigate the effects of the use of learning objectives with an audiovisual presentation on the intended (objective relevant) and incidental (non-objective relevant) learning outcomes. This study was designed to provide evidence regarding the facilitative effects of using learning objectives as an organizer with a fixed-pace, fixed-format, non-print medium.

Theoretical Foundations

The primary theoretical base for this study is anchored in the cognitive construct instructional theories and the concept of external organizers to facilitate learning as developed by Ausubel.[3] The use of learning objectives as organizing tools is derived from Gagne's principles,[4] and the concept of modifying learning activity by differential placement of the organizing device is developed from Rothkopf's[5] hypotheses of mathemagenic behavior.

In opposition to the more behaviorally oriented theories dominated by Skinner,[6] the cognitive construct instructional theorists attribute a greater degree of autonomy and initiative to the learner. Typically, they emphasize the student's internal representations or cognitive constructs as the really important concern in education.

Advance Organizers

Of particular interest to this study is the emphasis on organization as a critical component of the learning process as espoused by David P. Ausubel and others.[7] Ausubel has articulated these ideas into a theory of meaningful verbal learning which he calls the subsumption theory.[8]

Briefly, the theory holds that meaningful verbal learning can be incorporated into the learner's cognitive structure and there be retained more accessible, and for longer periods of time, if the cognitive structure initially contains discernible, relevant, and related bits of information (subsumers)

which the learner can associate with new learning. With the passage of time, the incorporated learning will undergo successive reformations (obliterative subsumption) as the learner attempts to condense and hierarchically arrange added learning.

Ausubel[9] has supported his theory with experimental evidence which indicates that (1) those students who are known to have relevant subsumers will remember more of the subsequent learning for a longer period of time compared to those who do not; and (2) low achievers exhibit greater increases in achievement with the aid of subsumers than high achievers. Ausubel attributes this effect to the apparent lack of organization in the cognitive structure of the low achievers. Externally imposed "advance organizers" provide the necessary organization in low achievers but are of little aid to high achievers who impose their own organization on unstructured material.

According to Ausubel and Robinson, optimal utilization of the principles of progressive differentiation and integrative reconciliation can be achieved by the "...supplementary availability of a hierarchical series of advance 'organizers.'"[10] True organizers, in Ausubel and Robinson's view, are not to be confused with ordinary introductory overviews which are typically written at the same level of abstraction, generality, and inclusiveness as the learning material and achieve their effect largely through repetition, condensation, selective emphasis on central concepts, and pre-familiarization of the learner with certain key words. They considered summaries as comparable to overviews, but probably less effective because their influence on cognitive structure is retroactive rather than proactive relative to the learning task. They felt overviews and summaries "insofar as they imply to some learners that the material they do not include is relatively superfluous . . . may promote neglect of and failure to study or review much significant subject matter."[11]

Ausubel and Robinson also felt advance organizers had "certain inherent advantages" over various kinds of intramaterial organization (adjunct organizing aids within the body of the material).[12] They reasoned that existing subsumers in cognitive structure lacked both particularized relevance for the new material (since the learner could not possibly anticipate its precise nature) as well as the sophisticated knowledge of subject matter and pedagogy available to expert programers.

Behavioral Objectives

The avenue to be explored by this study was the extent that learning objectives could be used as organizing devices for audiovisual presentations. Gagne is a principal proponent of the use of behavioral objectives as facilitators of learning. He states:

> Defining objectives for the student is an inadequately exploited educational technique . . . . (U)nless students know what the objectives are, they are likely to resort to memorization and mechanical completion of the exercises in textbooks or workbooks rather than carrying out relevant sorts of learning activities. When one tells the student what he is expected to do after he learns, he is not "giving him the answer." Rather it is providing him with a goal which he himself can use to organize his own learning activities.[13]

The use of objectives as organizational devices is also supported by Garrison and Magoon who state, "Organization is the process which converts the raw materials of learning into a constructive approach toward meeting an educational objective."[14] They emphasize the importance of objectives as a learning aid by the students in interacting with the instructional material by stating: "Learning experiences should correlate closely with the established objectives of which the learner has been fully apprised."[15]

Ellis also links objectives and organization as important conditions to learning from the student's viewpoint.

> A major feature of good study habits is that you understand the principle objectives or goals of whatever it is you are studying . . . . (K)eep in mind that you are trying to get a good "mental roadmap" of the material before you study it in greater detail.
>
> . . . If structure is not immediately evident in the material, then you must seek structure or create some kind of useful system for organizing the materials. This is simply to say that you must impose some kind of organization upon the materials . . . .[16]

Mathemagenic Behavior

Another theoretical area relevant to this study is the concept of mathemagenic behavior developed by Rothkopf and his associates. Rothkopf asserts that the effect of an instructional document can be affected to some degree by controlling the behaviors of the learner in relation to the document. Since these behaviors affect learning, Rothkopf has called them mathemagenic behaviors, a word of Greek origin which means behaviors "which give birth to learning."[17] He postulates that there is a variety of activities in which the instructor or learner can engage, which can modify, and to a degree control, mathemagenic behaviors.

Most of Rothkopf's research involves the use of questions inserted in written materials as a means of modifying mathemagenic behavior to increase learning. There have been a number of studies by Rothkopf and others to support his hypothesis. Several variables have been examined in the experiments but they all have one variable in common--question location. In general, Rothkopf's studies indicated that grouped pre-questions and adjunct pre- and post-questions resulted in greater learning of question-specific relevant knowledge than from either a no-question or grouped post-question treatment. He also found more learning of non-relevant question information by the adjunct post-question treatment only. The frequency of adjunct post-questions also tended to aid learning.[18]

Rothkopf suggests that pre-questions serve a cueing function of informing and directing the learner regarding important content. Post-questions do not affect selective attendance to the material but rather force a mental review of all material (both intended and incidental knowledge) in order to answer the question.[19]

Intended and Incidental Learning

The facilitative effects of using learning objectives as directions to learn relevant prose text material has been well documented.[20] The relative effects of objectives with respect to incidental (non-objective relevant) learning are less clear. Several studies have reported greater incidental learning for groups receiving objectives (or questions) than for non-objective control groups.[21] Other investigations have shown a decrease in learning performance when instructional objectives are presented before the learning materials. Duchastel and Brown,[22] for example, found that subjects who were given objectives performed somewhat more poorly on incidental material than a control group who received no objectives. The reason for the difference between the results of these experiments is not clear. Kaplan and Simmons[23] tested several hypotheses concerning the reasons for the observed increases in learning found in these studies. Specifically, they investigated the effects of the location of the instructional objectives with respect to the learning material (before vs. after). Their principal finding was that performance on information relevant to an objective was relatively high whether the objectives were presented before or after the text. Performance on incidental material was greater for objectives located after the text than before the text. These results are generally supported in other studies by Bruning,[24] Frase,[25] and Rothkopf[26] which show that overall retention tends to be greater when questions are located after rather than before text segments.

The general conclusion is that objectives or questions presented after the learning materials cannot be used as orienting stimuli which permit the learner to selectively attend to specific information in the text.

Virtually all of the research concerning behavioral objectives as organizing devices has been concerned with printed material. Lumsdaine, May and Hadsell[27] studied the effects on learning of supplementary instruction presented before or after a film. While they did not use "learning objectives" they did employ a variety of techniques to direct attention to specific information in the film content. Although intended learning did increase, the effects were small and the results inconclusive, particularly with regard to any effect to incidental learning. Dayton[28] conducted a recent investigation upon the effects of inserted questions in a slide-tape presentation. He found a significant increase in the amount of question-relevant learning but the effects on incidental learning were ambiguous.

In light of these studies, the following questions may be asked:

1. Does the insertion of learning objectives in slide-tape presentations result in greater learning than would occur as a result of a slide-tape presentation only?
2. What effect does the location of the learning objectives in respect to the presentation have on student learning from slide-tape materials?
3. What are the differential effects of the placement of learning objectives upon the intended and incidental learning by the student from slide-tape presentations, i.e., is the effect generally facilitating (results in greater learning of all content) or is it due only to review (results in greater learning of material relevant only to the learning objectives)?

Answers to these questions should provide useful information for people involved in the use of media as an instructional tool. Most of the audiovisual

presentations available have not been designed with specific terminal behavior patterns in mind. Frequently the materials used in instruction were not even intended for educational purposes. It would be of value to teachers, to producers of audiovisual programs, and to curriculum developers to know the effects the introduction of learning objectives to the program will have on facilitating the intended knowledge acquisition. The addition of learning objectives would add very little to initial production costs and could be added for minimal costs to existing inventories of slide and video programs. It would be more costly to insert learning objectives in motion picture prints, but supplemental projection of objectives by 35 mm projectors would be practical when using films.

This study may be of equal interest in defining the effect of the insertion of learning objectives on the acquisition of incidental knowledge. There has been a great rush to increase the use of behavioral objectives and their efficacy in improving learning outcomes is well documented. Less attention has been paid to their potential in terms of their effects on incidental learning. The results of this study should serve not only as a guide to benefits of inserting learning objectives in audiovisual presentations, but also as an indication of possible side effects of loss in incidental knowledge. This caution may be of significance in certain situations where the emphasis is to expand abilities to synthesize material rather than focus on information transfer. In addition, the answers to these questions would have implications in determining the validity of the propositions by Ausubel and Gagne and by expanding the implications to include the use of learning objectives as organizers for audiovisual materials.

Study Design

A controlled field experiment was conducted to measure the intended and incidental learning outcomes resulting from the use of learning objectives with a selected audiovisual presentation.

The experiment was designed to determine the effect and interaction of five independent variables with an audiovisual slide-tape program: presence of learning objectives, location of learning objectives, type of knowledge, sex of learner, and retention of learning. A 4x2x2 factorial design replicated for retention of learning was selected for the analysis. Student learning of intended knowledge and incidental knowledge, as measured by paper and pencil tests, were the dependent variables. The design model is at Figure 1.

A 20 minute commercially produced educational slide-tape presentation concerning advances in mass media and communications was used as the stimulus.[29] The participants were students enrolled in an introductory mass communication course at California State University, Chico, in the spring semester, 1977. The course was required for all communication majors and was, in addition, a service course for the University's general studies program. The course content was heavily mediated with almost every class meeting using a film, videotape, audiotape, or multimedia presentation to support the instruction. Students in the class were divided into three treatment groups and one control group by a random sampling procedure stratified for sex.

The treatment factor was the presence or absence of learning objectives. Learning objectives were used with the slide-tape presentation for experimental groups 1, 2, and 3. No learning objectives were available for experimental group 4 which constituted a control group.

The learning objectives for the course content contained in the slide-tape treatment material were established by interviewing the professor of the

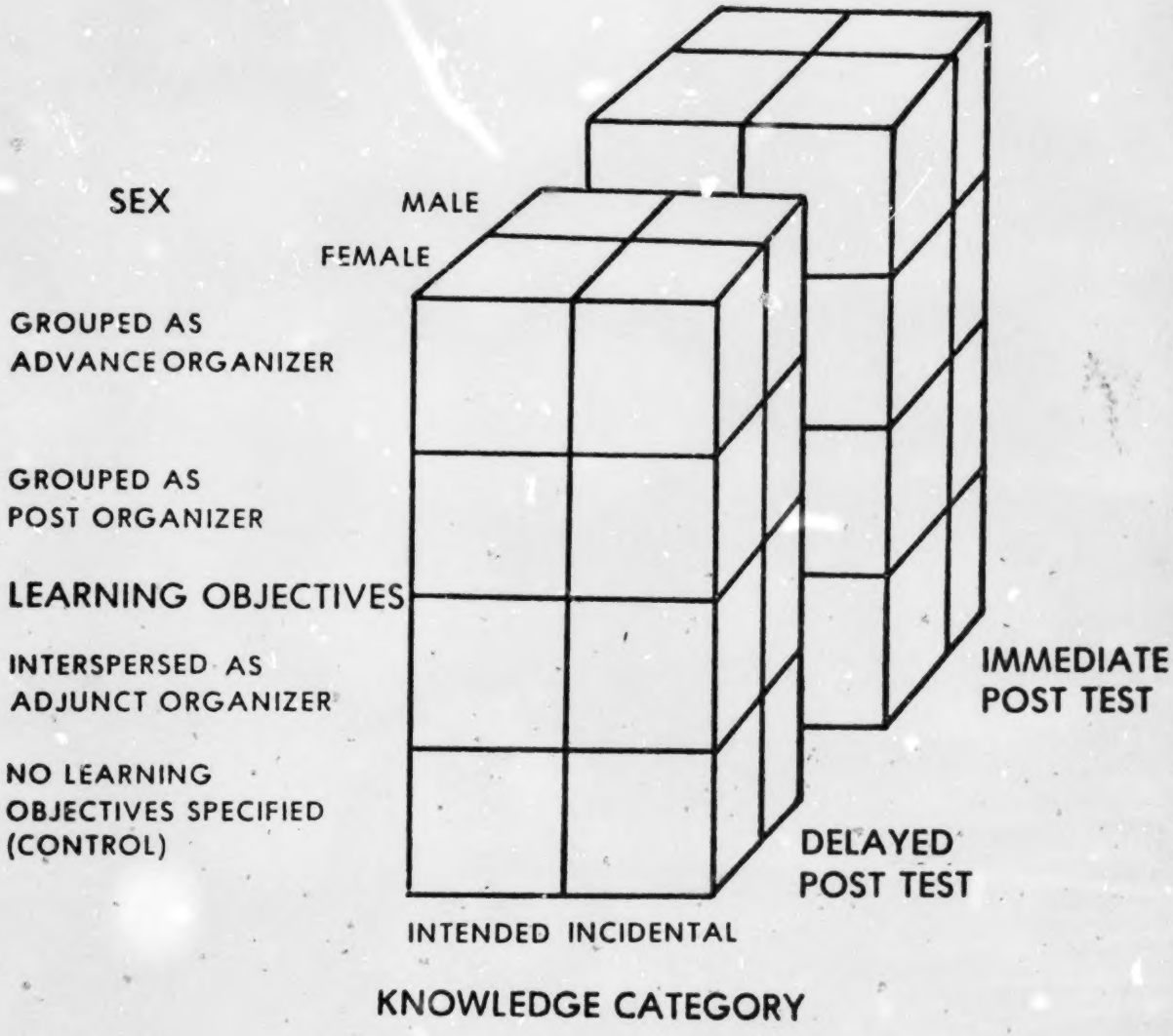

Figure 1

Experiment Model

The experiment uses a two-way analysis of variance including treatment (presence and location of learning objectives) and sex (male-female). The delayed intended and incidental knowledge posttest scores are subjected to identical analysis of variance allowing comparison of data. The immediate posttest scores are treated as a separate but identical experiment.

course, taking her educational aims and specifying the terminal behavior requirements. The initial objectives were then submitted to five professors who had previously taught the introductory mass communication course and were thus familiar with the educational aims of the particular block of instruction, but were not familiar with the slide-tape program. Each professor was asked to rank-order the learning objectives, modify as appropriate, and add or delete objectives if necessary. In addition, each professor was asked to furnish three questions designed to measure by paper-pencil method the intended behavior specified by each objective. From this modified list of learning objectives, four receiving consensual judgment as being appropriate were selected. Each learning objective was then reproduced on a 35 mm slide.

The location of treatment factor was the application of the learning objectives inserted as a group before the presentation (advance organizer), inserted as a group after the presentation (post organizer), and interspersed within the presentation (adjunct organizers). The audio track for the presentation was not changed except to add 10 seconds of silence for each behavioral objective slide.

The type of knowledge factor constituted the cognitive level of information relevant to the learning objectives (intended knowledge) and the cognitive level of information non-relevant to the learning objectives (incidental knowledge).

The intended and incidental knowledge content of the slide-tape presentation was determined by a content analysis. The program was presented to a graduate class in instructional theory and design. Copies of the script and the learning objectives were furnished each student, who was then asked to list the major points of information contained in the presentation that did not directly contribute to the learning objectives. This body of information

was designated as incidental knowledge and test questions were developed to measure the cognitive level of this incidental knowledge. All other information was considered intended or objective-relevant knowledge.

The instrument used to measure knowledge in the experiment was a pencil and paper test with three parts. Part one measured intended learning and consisted of 10 items provided by the learning objectives development panel as discrete measurements of intended learning behavior.

Part two of the instrument measured incidental learning and consisted of 12 items developed during the content analysis by the instructional theory and design class.

Part three of the instrument measured affective variables concerning the subject matter and the presentation. It consisted of 10 items each with a series of statements arranged in a Likert type semantic differential scale ranging in value from one through five. The variables measured were: (1) optimism concerning the contribution to society of communication technology, (2) the importance of communication media to society, (3) relevance of material to the class, (4) bias or objectivity of the presentation, (5) interest in the subject, and (6) evaluation of the presentation. The evaluation of the presentation was further defined by five categories:

1. Overall evaluation
2. Organization
3. Length
4. Quality of visuals
5. Format

The test items for measuring the affective domain were developed by the researcher and were not subjected to a validity or reliability test.

A pilot study to establish the validity of the test instruments was conducted by presenting the audiovisual presentation to 33 students enrolled in an undergraduate course in broadcast management. No behavioral objectives were given to the students. The test was administered immediately following the presentation.

The results of the pilot test indicated the internal consistency of the test instrument was acceptable with a Kuder-Richardson reliability of .75. This was considered satisfactory for the experiment's purpose.[30]

No analysis was made of the affective measurement items other than inspection to determine that variance was present. The learning retention factor was the cognitive level of intentional and incidental information measured immediately following the presentation and measured again after a 14 day time lapse.

The experiment was conducted on May 3, 1977 during the normally scheduled class meeting time. Viewing and listening factors were carefully controlled for each group. The subjects were directed by name to four separate and identical classrooms equipped with identical 35 mm Kodak slide projectors synchronized by identical Wollensak audiotape playback machines. Table 1 is the schedule of presentation treatments. The subjects observed the slide-tape presentations without additional instruction. Immediately following the presentation, a graduate assistant administered the examination. All questions were contained in a test booklet and the students recorded their responses on a standard machine graded answer sheet. This was the normal examination procedure employed for the class and consequently the students were familiar with the procedure.

Table 1

Presentation of Treatments

Group	Schedule
1	Learning objectives presented as a group in advance of slide-tape presentation
2	Learning objectives presented as a group at conclusion of slide-tape presentation
3	Learning objectives presented individually throughout presentation immediately preceding relevant portion of slide-tape presentation
4	Slide-tape presentation only; no learning objectives provided

In the follow-up test conducted on May 17, 1977, the subjects were given identical test booklets in their regular classroom, answered the questions, and turned in the booklets at the end of ten minutes. Part III (affective measurement) was deleted from the follow-up test booklets.

To avoid as much as possible the effects of learning from the test, the test booklets were collected after each post-test, and the results of the immediate post-test were not announced to the participants.

The Results

The raw test data collected on each student participating in the experiment consisted of 108 matched immediate and delayed post-test scores, equally divided into three treatment groups and a control group. The number and source of raw test data scores collected on each student and used for the analysis are listed in Table 2.

Additional data items on each participant were collected from student records maintained by the class instructor. These were sex, class level and grade point average (GPA) for the course. A chi-square statistic was computed

Table 2

Data Scores Available for Analysis

Data Item	Number and Source of Scores	
	Immediate Post-test	Delayed Post-test
Intended learning	108	108
Treatment 1	27	27
Treatment 2	27	27
Treatment 3	27	27
Control (no treatment)	27	27
Incidental learning	108	108
Treatment 1	27	27
Treatment 2	27	27
Treatment 3	27	27
Control (no treatment)	27	27
Affective domain		
Optimism	108	
Importance	108	
Bias	108	
Evaluation of presentation		
Overall	108	
Relevance	108	
Organization	108	
Length	108	
Visual quality	108	
Format	108	
Interest	108	

to test the "goodness of fit" of the sample distributions across each of these characteristics. The results indicated the sample groups were relatively homogeneous for the characteristics observed with no significant differences existing between distributions across sex, class level or grade point average.

The mean score of each treatment group for the intended and incidental knowledge measurements are displayed in Table 3. A graphic presentation of the dependent variables in percentage figures is shown in Figure 2.

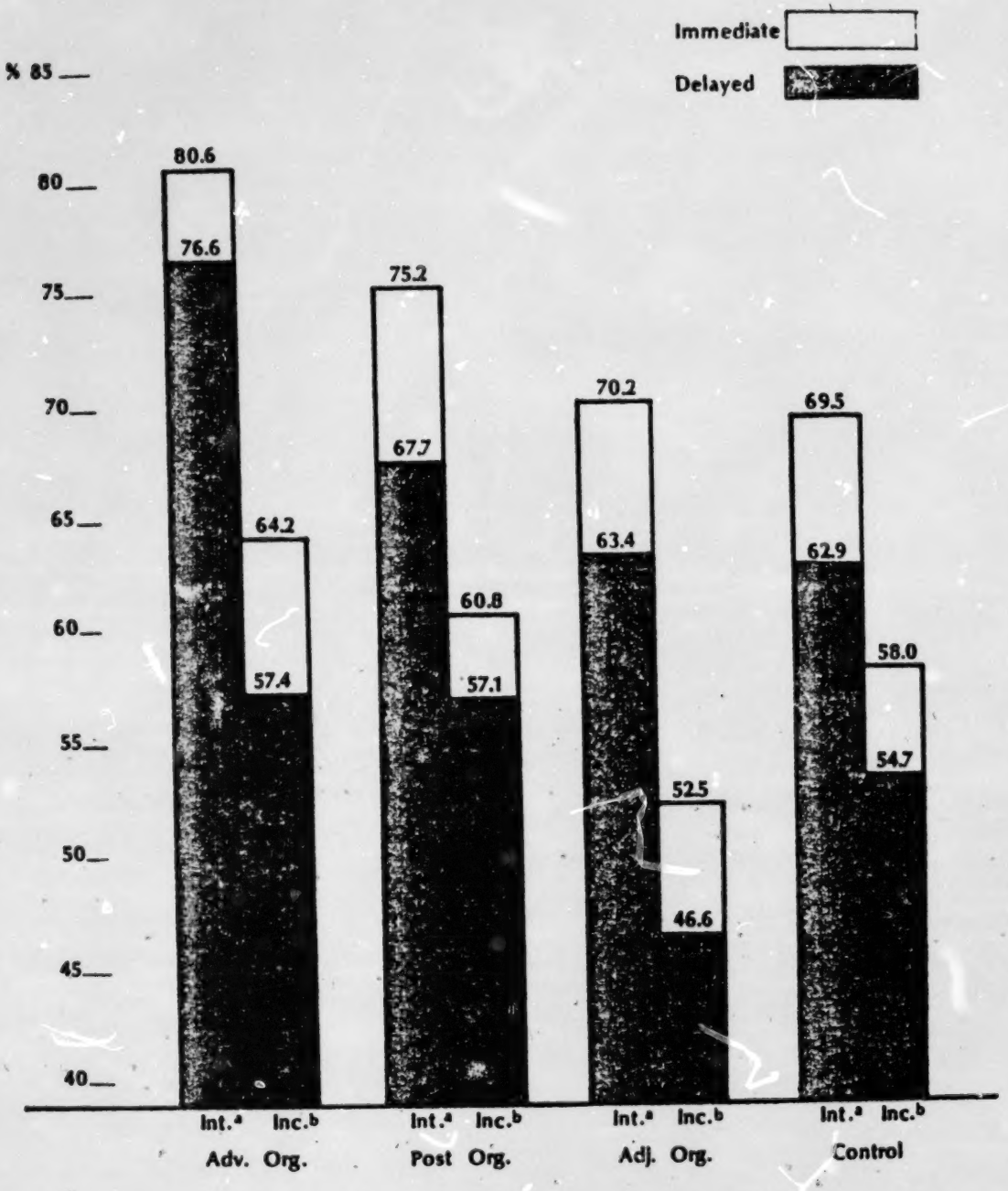

Figure 2

Pattern of Dependent Variable Scores by Knowledge Type and Experimental Group

[a]Intended knowledge percentage score.

[b]Incidental knowledge percentage score.

Table 3

Mean Scores of Test Responses

Knowledge Type		Treatment Group: Advance Org.	Post Org.	Adjunct Org.	Control
Delayed Intended	Mean	7.66	6.77	6.34	6.29
	S.D.	2.4	2.4	2.4	2.5
Immediate Intended	Mean	8.06	7.52	7.02	6.95
	S.D.	2.3	2.3	2.3	2.2
Delayed Incidental	Mean	6.89	6.85	5.59	6.56
	S.D.	1.9	2.3	2.2	2.0
Immediate Incidental	Mean	7.70	7.30	6.30	6.96
	S.D.	2.1	2.3	2.3	1.8

The Hypotheses Tests

There were three research hypotheses applied to the study. They were that under the conditions of the experiment:

1. There is no significant difference in cognitive learning outcomes of objective relevant (intended) knowledge in an audiovisual presentation as a result of the insertion of learning objectives.
2. There is no significant difference in cognitive learning outcomes of incidental knowledge in an audiovisual presentation as a result of the insertion of learning objectives.
3. Inserting learning objectives at the beginning, at the end, or interspersed during an audiovisual presentation has no significant difference in cognitive learning outcomes of either intended or incidental knowledge.

In the analysis, incidental and intended learning were considered separately using a two-way analysis of variance with treatment group and sex as factors.

The subject's grade point average, class standing, and study major were included as covariates in the analysis. In the event the ANOVAs revealed significance for either a main effect or the interaction, Scheffe's test of multiple comparisons was used to identify the source of the significance. The acceptable level of significance was set at $\alpha = .05$ throughout the analysis.

Intended Learning

Hypothesis one: There is no significant difference in cognitive learning outcomes of objective relevant (intended) knowledge in an audiovisual presentation as a result of the insertion of learning objectives.

$$H_{o_1} : \sigma E_j = \sigma E_c = 0$$

where E_j = experimental groups 1, 2, and 3 and E_c = experimental control.

The null for research hypothesis one was rejected for both the immediate and delayed post-tests. Intended learning was significantly greater at the .05 level when learning objectives were present. There was virtually no variation in scores attributable to sex differences, and there were no significant interactions between treatment and sex.[31] The covariate of class standing were also not significant. However, the grade point average (GPA) of the subjects was a significant covariate with the intended learning score for both the immediate and the delayed post-test.

Since no sex differences were indicated in the analysis, sex was deleted from all subsequent analysis of the intended learning variable.

Incidental Learning

Hypothesis two: There is no significant difference in cognitive learning outcomes of incidental knowledge in an audiovisual presentation as a result of the insertion of learning objectives.

$$H_{o_2} : \sigma E_j = \sigma E_c = 0$$

where E_j = experimental groups 1, 2, and 3 and E_c = experimental control.

The null for research hypothesis two was accepted for both immediate and delayed tests, but the trend of the results was the reverse of the expected direction. Although not statistically significant (α = .12 and α = .10 level for immediate and delayed scores respectively), incidental learning tended to increase when learning objectives were present. This trend was present whether the learning objectives were presented before the presentation (advance organizers) or after the presentation (post organizers), but was not present when the learning objectives were interspersed within the presentation (adjunct organizers). On the contrary, incidental learning was slightly lower for the adjunct organizers. As in the intended learning outcomes, sex differences were not significant nor was class standing significantly related to the incidental learning scores. As with intended learning, grade point average was a significant covariate (α = .001) with the incidental learning scores and appeared to account for much of the variance for both the immediate and delayed incidental post-test observations.

Location of Objectives

Hypothesis three: Inserting learning objectives at the beginning, at the end, or interspersed during an audiovisual presentation has no significant difference in cognitive learning outcomes of either intended or incidental knowledge.

Since the analysis of variance for incidental learning on both the immediate and delayed post-tests showed no significance for treatment main effects, further testing between groups was not warranted. Consequently, the null hypothesis for the incidental knowledge portion of hypothesis three was accepted by default, i.e., the location of learning objectives has no significant effect on incidental learning performance.

For the intended knowledge portion of hypothesis three, the significance of the differences in performance was tested using the Scheffe method:

$$H_{o_{3a1}} : \mu K_{j_1} = \mu K_c = 0$$

$$H_{o_{3a2}} : \mu K_{j_2} = \mu K_c = 0$$

$$H_{o_{3a3}} : \mu K_{j_3} = \mu K_c = 0$$

where K_j = intended knowledge for experimental groups 1, 2, and 3; and K_c = intended knowledge for experimental control.

The null hypothesis was rejected for the advance organizer experimental group. Placing the learning objectives at the beginning of the audiovisual presentation did significantly improve the intended learning performance on both the immediate and delayed post-test. The null hypotheses for use of the learning objectives as a post organizer and as adjunct organizers were accepted. Although the direction of intended learning performance was greater for both of these treatments than for the control group receiving no learning objectives, the results were not significant at the .05 level.

The Effects of Grade Point Average

Since the grade point average had shown a significant relationship in both the intended and incidental learning outcomes analysis, it was decided to test for possible interaction effects between the treatment and GPA. Specifically, the question arose as to whether the presence and location of learning objectives had a differential effect on high and low achievement students as measured by their overall class standing.

To test for the interaction between treatment and GPA, a two-way analysis of variance was conducted with both the immediate and delayed intended and incidental learning scores. The A and B subjects were grouped as high GPA students, and subjects with C and D grades for the course were designated as

low GPA students. It was hypothesized that high GPA students would possess superior organizing skills as evidenced by their demonstrated ability to master the curriculum content of the course. Therefore, the introduction of learning objectives as a device for organizing the intended learning material of the audiovisual presentation would have less beneficial effect. Students lacking highly developed internalized organizing skills, on the other hand, should find the learning objectives more facilitative in learning the objective relevant material presented in the slide-tape program but not in learning the incidental knowledge presented.

While intuitively reasonable, the data did not support this assumption. No significant interactions were present. The grade point average varied as scores varied, but not differentially for treatments.

Learning Retention

In examining the means for the immediate and delayed post-test scores, differences were noted in the amount of learning loss between the treatment groups. This was particularly noticeable for incidental learning results where the rank order of groups three and four were reversed between the immediate and delayed post-test. Ellis points out that the retrieval of information from memory is not independent of how it is stored. He states, ". . . if information is stored in an organized and systematic fashion, it has a better chance to be retrieved."[32]

To test the effects of the use and placement of learning objectives on the rate of learning decay of the intended and incidental knowledge, an analysis of difference scores was made. A paired difference variable was computed for each subject using a repeated measures loss score of $D = X_1 \ X_2$ for each knowledge type. A two-way analysis of variance was conducted with treatment and sex as the independent variables. The results of the analyses indicated

there were no significant differences in learning loss between the treatment groups or the sexes for either intended or incidental knowledge. Although no conclusions can be drawn, it is interesting that the group receiving learning objectives at the beginning of the presentation as advance organizers had the highest retention level for intended knowledge and the lowest retention rate for incidental knowledge, whereas the control group that received no learning objectives and the post organizer group that received the learning objectives at the end of the presentation had the better retention performance for incidental knowledge.

It is emphasized there was no significance in the analysis of differences in the loss of learning between treatment groups; therefore, any conclusions from these data would be unwarranted and misleading.

Affective Variables

Ten items were included in the immediate post-test that were designed to measure by means of semantic differential scales the attitudes of the subjects with regard to the content material and the manner of presentation. The variable names and source of data used in the analysis are presented in Table 2 (p. 15) under "Affective domain" and "Evaluation of presentation." A factor analysis procedure was used to reduce the number of factors that could be used as source variables for testing the variance between treatment groups.

As a result of the factor analysis, the ten variables were restructured into three groups that were defined for further analysis. The variable "optimism" was retained as a unique factor. The variables "importance" and "bias" were combined as a new factor "content evaluation." The remaining seven variables were grouped into a single factor designated "presentation evaluation." The means for these new generated factors by treatment group are displayed graphically in Figure 3.

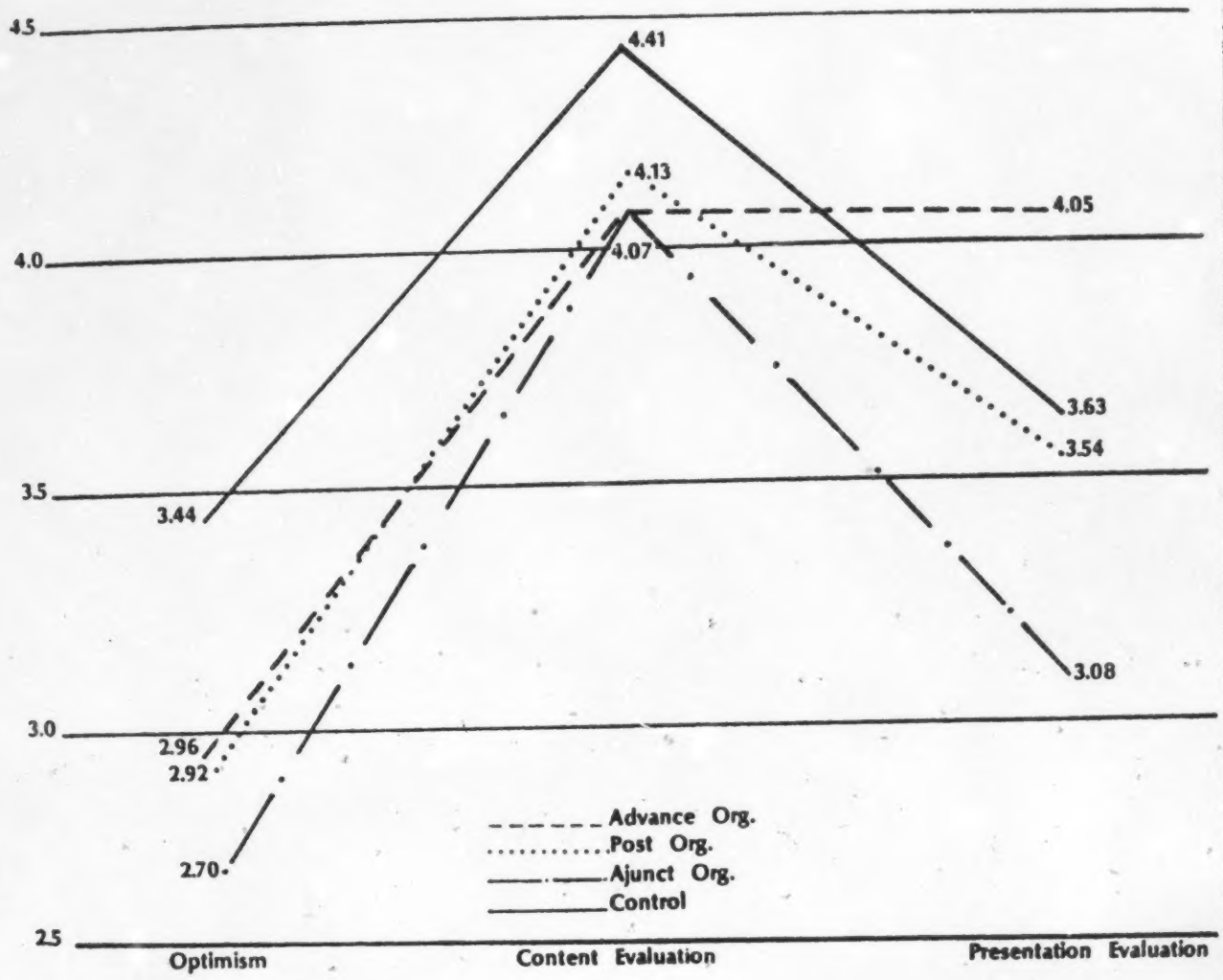

Figure 3

Pattern of Response on Affective
and Evaluation Factors

Scores derived from semantic differential scale where 5 = high, 1 = low.

The optimism variable measured the subject's feelings regarding the effects the new communication technology would have on the quality of our future life. The scale ranged from "greatly enhanced" (5) to "greatly degraded" (1). Generally, the treatment groups appeared more pessimistic than the control group with the group receiving the learning objectives as adjunct organizers being the most pessimistic. The differences were not dramatic, however, since less than one point on the five point scale (high = 3.44, low = 2.70) separated the extremes.

The range for treatment group means was even less on the content evaluation factor (high = 4.41, low = 4.07). All of the experimental groups considered the subject matter of importance in that communication media would have an expanding role and an increasingly dominant impact on society. They also perceived the presentation as being relatively unbiased in presenting a balanced treatment of the dangers and benefits of the new media technology as evidenced by the four plus mean ratings on a five point scale.

The greatest range between the experimental groups occurred in the evaluation of the presentation. Each subject rated the presentation on how they liked it overall, how appropriate it was for the course, the content organization, the length, the quality of the visuals presented, whether they would have preferred a different format, and on how interesting it was compared to other presentations. Although the mean rating for all four groups was generally favorable, there was almost a full point difference between the highest mean of 4.05 for the group receiving the learning objectives at the beginning of the presentation and the lowest mean of 3.08 for the group receiving the learning objectives as adjunct organizers throughout the presentation. It appears that inserting the learning objectives during the presentation may have disrupted the content organization and created some annoyance in the viewers.

To test the significance of the differences between the experimental groups' affective and evaluation scores, two-way analyses of variance were conducted. The independent variables were treatment and sex and the dependent variables were the optimism, content evaluation, and presentation evaluation variables generated by the factor analysis.

The analysis indicated there were no significant differences in the subjects' scores on optimism and content evaluation between the experimental groups. Female participants were significantly more pessimistic about the future degradation of the quality of life through the improper exploitation of new communication technology than were the male subjects. However, since there was no significant interaction with the treatment, the result was of little interest to this study.

There was no significant variance in content evaluation scores attributable to either treatment or sex differences.

The evaluation of the presentation itself did, however, show significant treatment effects. Sex had no appreciable effects on the presentation evaluation scores. A Scheffe test of the differences in experimental group means verified the difference between the advance organizer and adjunct organizer group was significant at the .05 level. None of the other comparisons was significant.

The results of all statistical analyses are summarized in Table 4.

Discussion

The findings of this study generally support and extend Ausubel's theory of advance organizers facilitating learning. They are consistent with results obtained by Kaplan,[33] Kaplan and Simmons,[34] and Keyser[35] regarding the efficacy of using learning objectives as advance organizers with prose materials. The length of treatment used in this experiment was relatively short, but since

Table 4

Summary of Statistical Analysis

Independent Variable	Dependent Variable: Immed. Int. Learning	Immed. Inc. Learning	Delayed Int. Learning	Delayed Inc. Learning	Analysis Method
Experimental Factors					
Treatment	Sig.[a]	N.S.[b]	Sig.[a]	N.S.[b]	ANOVA
Sex	N.S.	N.S.	N.S.	N.S.	ANOVA
Treatment x Sex	N.S.	N.S.	N.S.	N.S.	ANOVA
GPA	Sig.	Sig.	Sig.	Sig.	Covariate
Treatment x GPA	N.S.	N.S.	N.S.	N.S.	ANOVA
College Major	N.S.	N.S.	N.S.	N.S.	Covariate
Class Standing	N.S.	N.S.	N.S.	N.S.	Covariate
Retention					
	Int. Learning Loss		Inc. Learning Loss		
Treatment	N.S.		N.S.		ANOVA
Sex	N.S.		N.S.		ANOVA

Comparison Tests (Scheffe)[c]	
Dependent Variable	
Intended Learning (Immediate and Delayed Post-test)[d]	Adv. Org. > Control
	Adv. Org. > Adj. Org.
Presentation Evaluation	Adv. Org. > Adj. Org.

[a]Test for hypothesis one: null rejected.

[b]Test for hypothesis two: null accepted.

[c]Only those comparisons significant at the .05 level are shown.

[d]Test for hypothesis three: null rejected for intended learning; null accepted for incidental learning.

most audiovisual presentations used as curriculum support are of relatively short duration (one hour or less in length), it would appear that the efficacy of learning objectives used as an advance organizer has strong support.

Locating the learning objectives at the conclusion of a slide-tape presentation or interspersed throughout with the relevant content did not have a significant effect on improving either the intended or incidental learning outcomes. Although the mean scores of the post organizer group were higher than those for the group receiving no learning objectives, the lack of significance limits the support of this study for the use of learning objectives for mathemagenic activities as defined by Rothkopf.[36] Previous attempts to extend the mathemagenic activities hypothesis to audiovisual media have been ambiguous. Dayton concluded that the use of either inserted or grouped post questions would increase intended learning, but that ". . . the use of either inserted or grouped factual knowledge post-questions in fixed-pace, fixed-sequence presentations would not, by itself, ensure an increase in incidental learning."[37]

Based on the results of the present study, it appears the use of learning objectives as post organizers or adjunct aids are what Rothkopf called "mathemagenic neutral," that is, they have no observable effect on the student's ability to retain new information.[38]

A possible explanation of the lack of facilitation of learning when the learning objectives were used as adjunct organizers lies in the nature of the medium. The audiovisual program used for the stimulus response was well organized, tightly structured, with a high degree of aesthetic quality. The insertion of the learning objectives during the presentation could have been very intrusive for the viewer, interrupting the narrative and visual flow of the production and generating frustration or anger. This could have served as an inhibiting condition for the arousal factors and attention devices of the highly professional production values contained in the presentation.

This hypothesis is supported by the results of the presentation evaluation scores. In general, the adjunct organizer treatment group liked the presentation least. Their scores were the lowest on every presentation evaluation item, and they were significantly lower than all three experimental groups for organization. Overall, the advance organizer treatment group liked the presentation more than the other experimental groups. Their evaluation scores were significantly higher than the other three experimental groups for organization, quality of the visuals, and format. In addition, the advance organizer treatment group rated the presentation significantly higher than did the adjunct organizer treatment group for overall evaluation, length, and interest.

The lack of significant difference in the incidental learning outcomes is of some importance. It contradicted findings by Kaplan and Burgin[39] that the use of learning objectives decreased incidental learning with both prose and videotaped instructional materials.

The effectiveness of learning objectives to improve intended learning performance from text materials has been well documented in the literature. The general hypothesis has been that the increased learning stems from the use of the objectives by the learner as directions to learn particular topics within a text (Rothkopf and Kaplan,[40] Kaplan and Rothkopf,[41] Kaplan,[42] and Duchastel and Brown[43]). The concept that they serve as orienting stimuli that permit selective attention to the relevant materials of the text was supported by data showing students took more time when learning objectives were provided (for review of relevant material) and that performance on incidental learning items for students not receiving objectives was much greater. This was explained as being the result of the students' reading non-selectively, i.e., giving equal attention to all material when learning objectives are absent.[44]

The results of this study appear to support a different interpretation of how learning objectives are used by subjects when the instructional material is a fixed-pace, fixed-sequence medium.

Looking at the trends in the data and not merely at the significant levels of effects, it appears the use of learning objectives improved learning performance on the immediate post-test for both the advance and post organizer groups. It can be speculated that in these treatments, the learning objectives serve an organizing function by establishing a categorical structure for examining the information in the audiovisual presentation. In the case of the learning objectives inserted at the beginning of the presentation, the information is considered and coded or filed by the viewer under the appropriate category as it unfolds. When the learning objectives are provided at the conclusion of the presentation, the viewer must conduct a mental review of the presentation reorganizing the material according to the new structure. In either case, the process of considering the information and determining objective relevance (intended knowledge) or non-relevance (incidental knowledge) improves recall for the post-test.

The significant relationship between the grade point average of a student and the score obtained on both intended and incidental knowledge was not surprising. Better students should be expected to perform better than poorer students. It was somewhat surprising that no interaction was found, however, since ability to organize material should be one of the factors in learning performance.[45] It would seem reasonable, therefore, that if learning objectives provide an organizing function they would be more beneficial to those students without highly developed internalized organizing skills, i.e., the poorer students. The lack of interaction indicates this did not happen.

Conclusions and Implications

The most substantive finding was that presentation of learning objectives as an advance organizer facilitated the intended learning for a slide-tape audiovisual presentation. Of particular interest was that these findings were also observed after a two-week delay. Thus, the facilitative effects of prior presentation of learning objectives was found for delayed as well as immediate recall.

Although no significant effects were found for the facilitation of incidental learning, the acceptance of the null hypothesis was of considerable importance for instructional strategy. The conclusion drawn is that instructors may present learning objectives prior to audiovisual presentations with the expectation they will enhance the learning of the objective relevant material without inhibiting the amount of non-objective relevant material learned. From the direction of the data, it appears the tendency was for the learning objectives to improve rather than lessen incidental learning outcomes.

Also of importance for instructors and producers were the findings that the use of the learning objectives as an advance organizer had no significance for the affective variables measured and they did not detract from the students' evaluation of this presentation. To the contrary, the trend of the data indicated the students receiving the learning objectives prior to the presentation liked the presentation more than when no learning objectives were used.

It would be unreasonable to expect that the producers of commercial audiovisual educational materials would provide learning objectives as an integral part of their presentations. Such materials are designed for the widest possible market and the specification of objectives might limit the application of the material or, if not, be so vague and encompassing as to negate their effectiveness. In addition, there is a great deal of audiovisual

material (including television programing) that can be used for curriculum support although it is not designed for educational purposes.

Learning objectives can be developed by instructors for the audiovisual materials they use. The insertion of the learning objectives prior to the presentation of the audiovisual program can be accomplished rather easily. If the primary concern of the user of audiovisual materials is to increase intended learning, the insertion of learning objectives prior to the presentation is recommended.

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--Covariates: adjust for factors and all other covariates;
--Factors: adjust for covariates and all other factors;
--Interactions: adjust for covariates, factors, and all other interactions of the same or lower orders.

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